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## Space Weather Technical Forecast

Issued on Tuesday, 09 April 2024 at 01:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

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**Space Weather Forecast Headline: Increasing chance of M-flares during this period.**

### Analysis of Space Weather Activity over past 24 hours.

**Solar Activity:** Solar activity has been Low, with just a couple of minor C-class flares in the last 24 hours. There are now five sunspot regions on the visible disc. AR3628 near north centre disc is the largest, with a faint negative leader spot. AR3633 in the southeast remains a fairly simple bipolar spot, but has shown signs of growing some intermediate spots of late. All other spots remain simple, with limited development.

There have been no Earth-directed CMEs observed in available imagery.

**Solar Wind / Geomagnetic Activity:** The solar wind has shown evidence of two events in the last 24 hours. A transient weak CME appears to have arrived at Earth at 08/0125UTC and then a solar sector boundary crossing (SSBC) took place around 08/0900 UTC. This was originally thought to be the onset of a high speed stream from CH20, but with no wind speed increase this is now considered unlikely. Wind speeds reached around 400km/s due to the arrival of the CME, but declined thereafter, and are now near 370 km/s. Density was below average, rising after the CME arrival to a peak of 17ppcc at 08/0900 UTC when the SSBC occurred, before dropping back to below average. Total magnetic field strength was mostly weak, but briefly peaked near moderate after the CME arrival. The north-south component, Bz, was weakly variable between +6/-7nT. Phi angle was initially negative (towards the Sun), but became positive from 08/0909UTC. Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10MeV) observed at GOES-18 was at background levels. High energy electron flux (greater than 2MeV) observed at GOES-16 was at background levels. The associated 24-hour fluence remained well below the Active (1e8 integrated flux) threshold, on a declining trend, with a value of 1.93e6 integrated pfu at 09/0000UTC.

### Four-Day Space Weather Forecast Summary

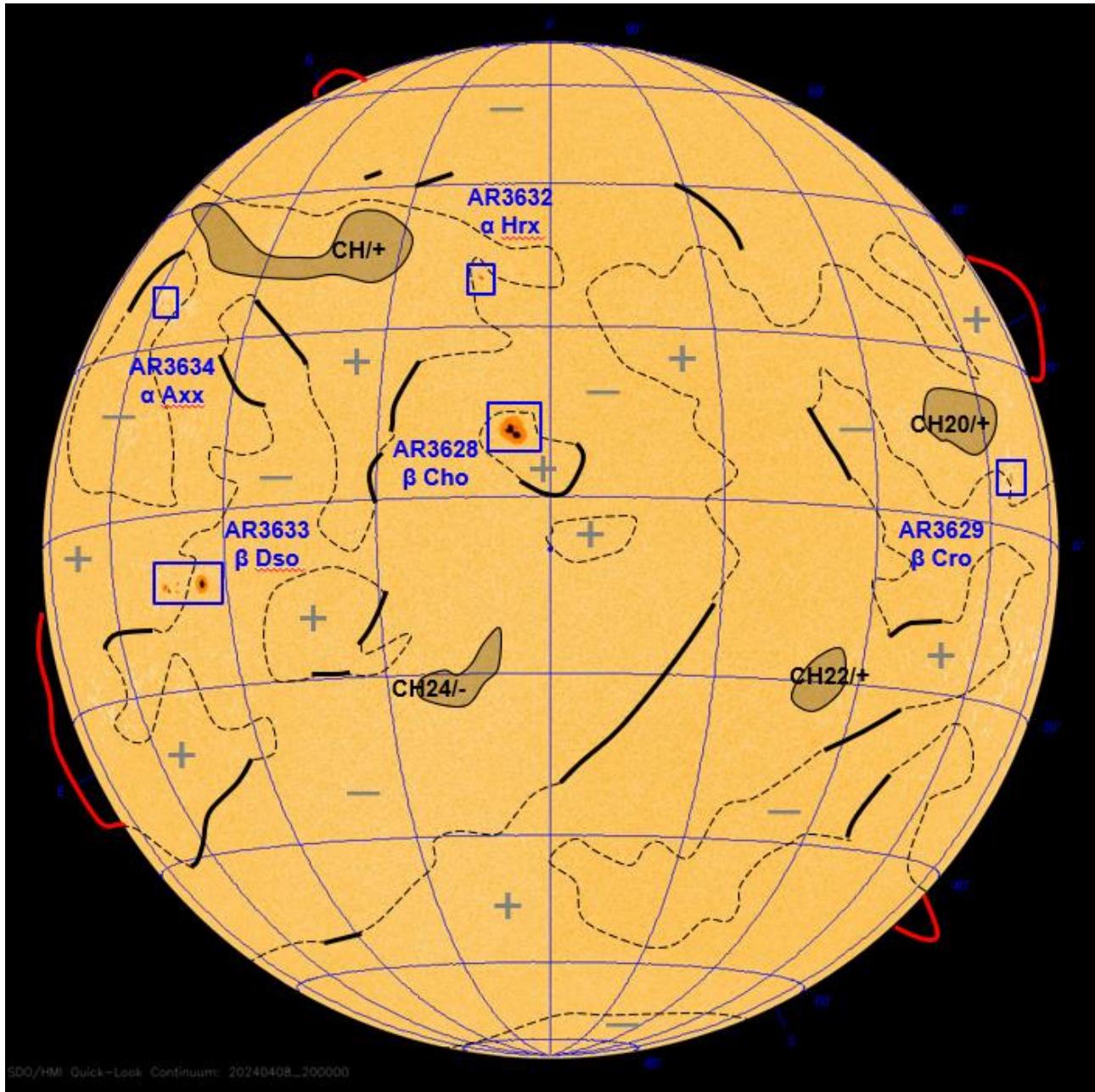
**Solar Activity:** Low to Very Low activity is expected at first with a slight chance of M-flares. This potentially increasing at the end of the period as ex-AR3615 starts to return.

**Solar Wind / Geomagnetic Activity:** There are no Earth-directed CMEs. Solar wind speeds are now at background levels after some slight enhancement in the last 24 hours, likely due to a weak transient CME and also a solar sector boundary crossing or some brief weak interaction with the high speed stream from CH20. Wind speeds are expected to be at background levels, or perhaps slightly elevated should there be any weak high speed stream influence. Mainly Quiet to Unsettled geomagnetic activity is expected, perhaps with an isolated Active interval.

**Energetic Particles / Solar Radiation:** High energy proton flux as observed by GOES-18, is expected to persist at background levels. High energy electron flux at GOES-16 is expected to continue at background levels. The associated 24 electron fluence is expected to remain well below the Active (1e8 integrated pfu) threshold.

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Figure 1. Solar Analysis Valid 08/2000 UTC.



**Key:** Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson  $\alpha$ - $\beta$ - $\beta\gamma$ - $\beta\gamma\delta$  and Zurich-McIntosh Axx etc.

**Geomagnetic Storms:**

There are no Earth-directed CMEs.

Solar wind speeds briefly reached slightly elevated levels, likely due to a weak transient CME. As this subsided there was a further enhancement in the solar wind, which was initially thought to be the high speed stream from coronal hole 20. However, the wind speed remains at background levels, and this enhancement may have just been a solar sector boundary crossing. A further small coronal hole 22 is potentially moving into a geoeffective position, but like coronal hole 20 is very small and positive polarity, which is not favoured for geomagnetic response at this time of year. Set against all this is the forecast from Enlil, which is suggesting a strong high speed stream throughout this period with wind speeds peaking near 600 km/s. According to Enlil, Earth should already be in a strong high speed stream, and it is considered likely that Enlil is significantly overdone in its forecast. As such, wind speeds are expected to be at background levels, or perhaps slightly elevated should there be any weak high speed stream influence.

Mainly Quiet to Unsettled geomagnetic activity is expected, perhaps with an isolated Active interval.

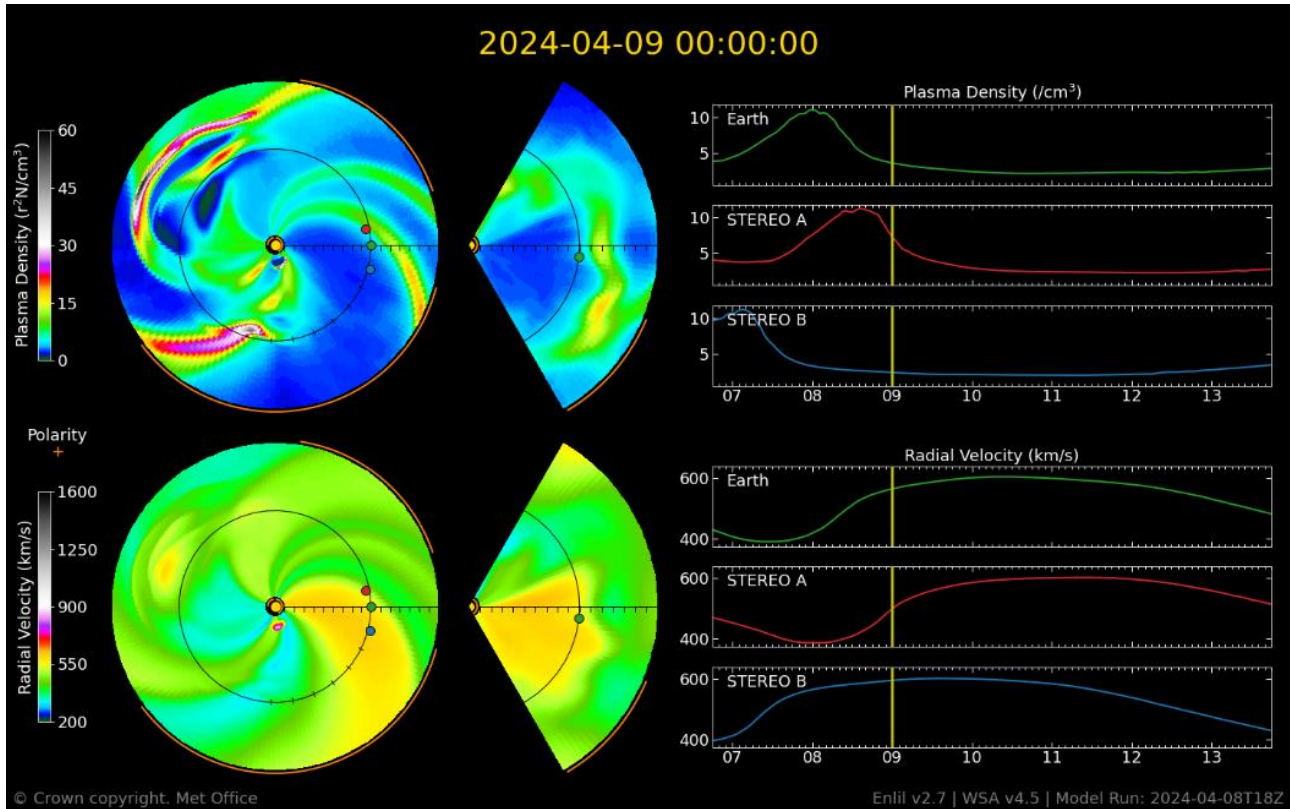
| Geo-Magnetic Storm          | Level    | Past 24 Hours<br>(Yes/No) | Day 1<br>(00-24 UTC) | Day 2<br>(00-24 UTC) | Day 3<br>(00-24 UTC) | Day 4<br>(00-24 UTC) |
|-----------------------------|----------|---------------------------|----------------------|----------------------|----------------------|----------------------|
| Probability<br>(Exceedance) |          |                           | (%)                  | (%)                  | (%)                  | (%)                  |
| Minor or Moderate           | G1 to G2 | No                        | 1                    | 1                    | 1                    | 1                    |
| Strong                      | G3       | No                        | 1                    | 1                    | 1                    | 1                    |
| Severe                      | G4       | No                        | 1                    | 1                    | 1                    | 1                    |
| Extreme                     | G5       | No                        | 1                    | 1                    | 1                    | 1                    |

**Geomagnetic Activity - Earthbound Coronal Mass Ejections**

No Earth directed CMEs are currently expected.



Figure 2: MOSWOC Enlil suggesting Earth should already be experiencing a strong high speed stream. This is considered overdone, with wind speeds currently below 400 km/s.



## Radio Blackouts - X-Ray Flares:

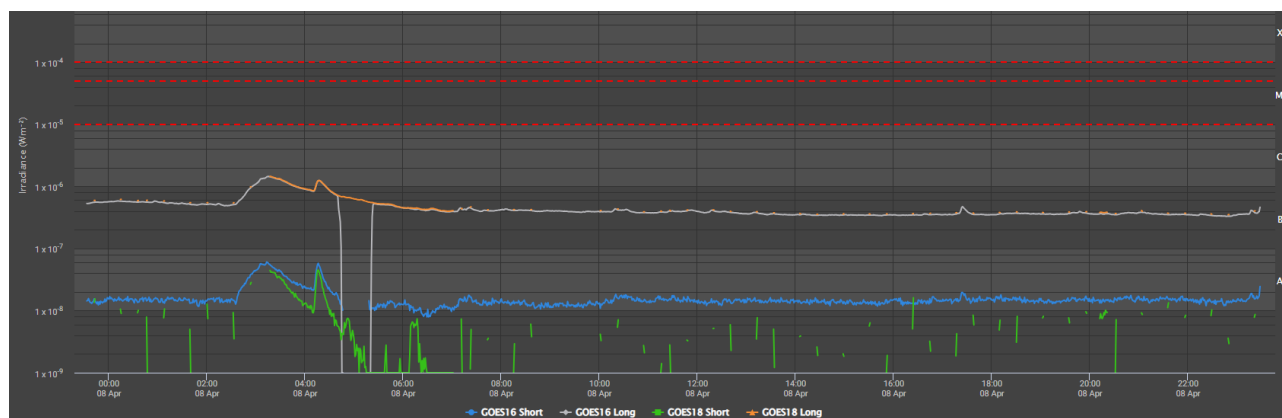
Solar activity has been Low, with just a couple of minor C-class flares in the last 24 hours. There are now five sunspot regions on the visible disc. AR3628 near north centre disc is the largest, with a faint negative leader spot. AR3633 in the southeast remains a simple bipolar spot, but has shown signs of growing some intermediate spots of late. All other spots remain simple, with limited development.

Far side seismographs suggest little in the way of significant regions to rotate on for another 2-3 days. However, later on Day 4 (12 Apr), we are likely to see the leading edge of ex-AR3615 which was a significant region on the last rotation. This region could be seen until recently on Mars Perseverance imagery, and corresponds to an enhanced area which matches its likely location on far side seismographs.

Low to Very Low activity is expected at first with a slight chance of M-flares. This potentially increasing towards the end of the period as ex-AR3615 starts to return, although a proper assessment of the flare risk associated with this region now will have to wait until it becomes fully visible, which is unlikely to be until after the end of this period.

| X Ray Flares | Level            | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|--------------|------------------|------------------------|-------------------|-------------------|-------------------|-------------------|
| Probability  |                  |                        | (%)               | (%)               | (%)               | (%)               |
| Active       | R1-R2 M Class    | No                     | 15                | 20                | 30                | 40                |
| Very Active  | R3 to R5 X Class | No                     | 1                 | 1                 | 1                 | 5                 |

**Figure 3: X-ray flux at GOES16 and 18, showing Low to Very Low activity.**



## Solar Radiation Storms - (High Energy Protons):

High energy proton flux as observed by GOES-18 is at background levels and expected to persist there through this period, with the currently visible active regions not expected to bring a risk of proton rich flares.

| Radiation Storms            | Level<br>( $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$ ) | Past 24 Hours<br>(Yes/No) | Day 1<br>(00-24 UTC) | Day 2<br>(00-24 UTC) | Day 3<br>(00-24 UTC) | Day 4<br>(00-24 UTC) |
|-----------------------------|----------------------------------------------------------|---------------------------|----------------------|----------------------|----------------------|----------------------|
| Probability<br>(Exceedance) |                                                          |                           | (%)                  | (%)                  | (%)                  | (%)                  |
| Active                      | $\geq \text{S1}$                                         | No                        | 1                    | 1                    | 1                    | 1                    |
| Very Active                 | $\geq \text{S3}$<br>*                                    | No                        | 1                    | 1                    | 1                    | 1                    |

\*  $\text{S3} \geq 10 \text{ MeV} \geq 1000 \text{ pfu}$  and / or  $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$ . (pfu =  $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$ )

## High Energy Electrons Event ( $\geq 2\text{MeV}$ ):

High energy electron flux is currently at background levels and likely to remain so through this period. Any high speed stream is now expected to be either very weak or not materialise, and as such we are not expecting the solar wind input necessary to increase electron flux.

Electron fluence is forecast to remain well below the Active ( $1\text{e}8$  integrated pfu) threshold, with REFM giving good guidance.

| GEO Electron Environment | Level ( $\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$ ) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|--------------------------|-----------------------------------------------------------|------------------------|-------------------|-------------------|-------------------|-------------------|
| Probability (Exceedance) |                                                           |                        | (%)               | (%)               | (%)               | (%)               |
| Active                   | $\geq 2 \text{ MeV}$<br>$\geq 1 \times 10^8$              | No                     | 1                 | 1                 | 1                 | 1                 |
| Very Active              | $\geq 2 \text{ MeV}$<br>$\geq 1 \times 10^9$              | No                     | 1                 | 1                 | 1                 | 1                 |

Figure 4: MOSWOC REFM showing a below Active trend through the next three days.

